

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Thomas M. Tillotson et al.      Attorney Docket : IL-10575C  
Serial No. : 09/981,076      Art Unit : 1713  
Filed : October 16, 2001      Examiner : H. Hu  
For : Method for Producing Nanostructured Metal Oxides

DECLARATION UNDER 37 CFR §1.132

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

I, Alexander E. Gash, hereby declare that I am a citizen of the United States of America and a resident of Brentwood, California.

I have a PhD in Inorganic Chemistry from Colorado State University.

I am a Materials Chemist in the Chemistry and Chemical Engineering Division with the University of California, Lawrence Livermore National Laboratory at Livermore, California.

I have worked at Lawrence Livermore National Laboratory as a Materials Chemist for six (6) years.

I have read the office action and would like the examiner to consider my comments concerning the obviousness rejections.

*Case 1. Prior Art: Inamura (5,788,950) and Ryang (5,962,608)*

Our application is not obvious from the combination of the two pieces of prior art cited above.

In both cases, the mode and mechanism of gel formation is entirely different from that stated in the present application. In the cases of the prior art, a gel is formed through either the swelling of an organic polymer (Inamura) or the photo or thermal-induced polymerization of organic monomers (e.g., acrylics) that crosslink to form a rigid gel structure. In both of these methods the organic component of the gel is used to *physically* entrap the inorganic sol component of the mixture. That is, the gel has entrapped a solution that contains dissolved inorganic precursors in it. Upon thermal treatment of this composite the organic component is burned away, the solvent evaporated, and the inorganic salt species degraded to the final *inorganic polymer* that takes the form of a powder.

In our description the organic component acts as a reagent that reacts and drives the *chemical condensation* of the inorganic precursors to a polymeric network. Quite simply our method drives the formation of the network through manipulation of the solution chemistry and not through the *physical* entrapment followed by high temperature decomposition.

Further, in our process the organic epoxide that is added drives the solution reaction chemistry towards formation of the inorganic oxide network. That is the epoxide reacts in solution to increase the pH of the solution, which drives the hydrolysis and condensation of inorganic precursors in solution to form the inorganic metal oxide network. In the prior art this is not accomplished. In fact in

these examples the organic component undergoes physical swelling to entrap the solution that contains the inorganic precursor. The phenomena that take place in solution are physical and not chemical in nature like our process.

Our approach does not require the use of high temperature drying methods to form the desired product as does Inamura and Ryang. Another example of the differences in the method is the final forms of the inorganic polymer. Using the prior art cited only yields powders of the final product whereas our methodology can lead to the formation of macroscopic monolithic single body pieces of the desired material as well as powders. This is specifically called out in the present claim 9, which states "an inorganic monolithic nanostructured metal-oxide aerogel or an inorganic monolithic nanostructured metal-oxide xerogel".

*-This last point is true of all four of the prior art teachings, none of which teach monoliths of nanostructured metal oxides.*

*Case 2. Prior Art: Ong (5,698,483) and Ryang (5,962,608)*

As with the previous case both of these pieces of prior art teach the preparation of nanostructured metal oxide powders through the use of physical entrapment of inorganic precursors in an organic gel matrix (e.g., swelled hydrophilic organic polymers such as polyethers, and acrylates) followed by high temperature removal of the organic gel network and decomposition of the

precursors. Our claims involve manipulating the chemistry of the solution that leads to an *inorganic* gel forming. That is the support structure of the gel is made up of a nanostructured network of inorganic oxide solid that is physically very different than the organic network utilized in this cited art.

There is no teaching of monolithic parts with either of these methods.

*Case 3. Prior Art: Ong (5,698,483) and Braithwaite (3,981,979)*

Ong is a significantly different method than what we have claimed. In fact there is little relating Ong to our method, as is detailed above. Since Ong is not applicable, a combination of Braithwaite and Ong is moot.

Regarding Braithwaite, again a significant distinction is our methodology results in macroscopic monolithic pieces of nanostructured metal oxide whereas Braithwaite only gives powders. In addition, Braithwaite only claims aluminum oxide with this method whereas we demonstrate a larger synthetic variety resulting in a number of important metal oxides.

Our claims are not a trivial extension of Braithwaite. Other metal oxides that we claim have varied oxidation states, which strongly affect their solution behavior. These species required utilization of distinct methods called out in our claims to help control their organized and homogeneous nucleation and subsequent gel formation. It is this control that lends itself to the important properties of the resulting materials. Trivial extension of Braithwaite's art would lead to products

with significantly altered and undesirable properties (e.g., lower surface area, non-uniform particle sizes).

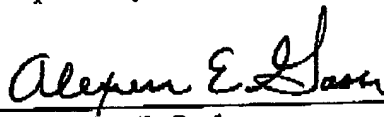
*Case 4. Prior Art: Inamura (5,788,950) and Braithwaite (3,981,979)*

Anything that would be here would be redundant relative to cases 1 and 3 above.

Accordingly, I respectfully request that the rejections be withdrawn.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

  
Alexander E. Gash

Dated: May 23, 2005